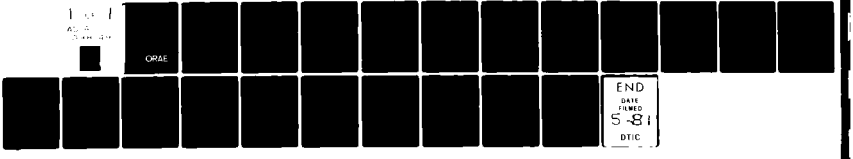
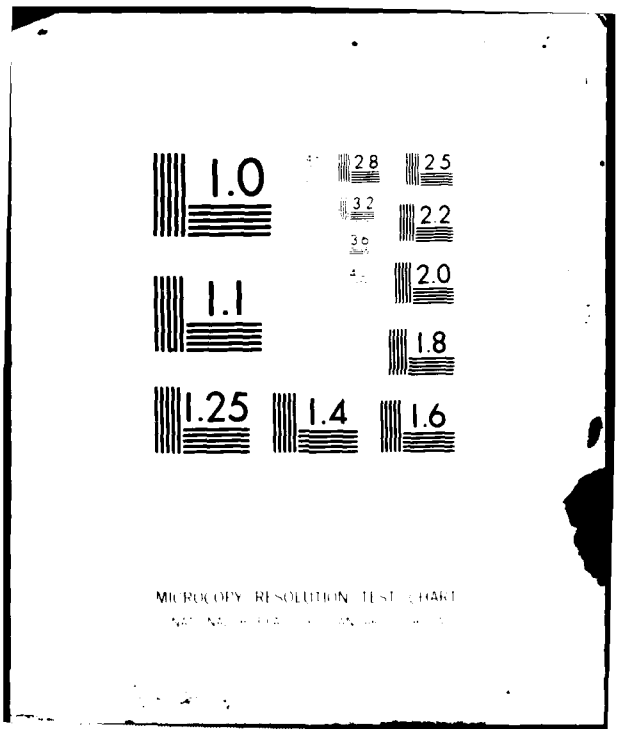
AD-A098 149 OPERATIONAL RESEARCH AND ANALYSIS ESTABLISHMENT OTTA--ETC F/G 15/3
OPERATIONAL RESEARCH: FLEXIBLE RESPONSE TO THE NEEDS OF CANADIA--ETC(U)
NOV 80 G R LINDSEY

UNCLASSIFIED ORAE-M103 NL




1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6
MICROCOPY RESOLUTION TEST CHART

OPERATIONAL RESEARCH: FLEXIBLE RESPONSE TO THE NEEDS OF CANADIAN DEFENCE THROUGH THE POSTWAR YEARS

BY

G.R. LINDSEY

ORAE MEMORANDUM NO. M103

ORAE

OPERATIONAL RESEARCH AND ANALYSIS ESTABLISHMENT

DEPARTMENT OF NATIONAL DEFENCE

OTTAWA, CANADA

NOVEMBER 1980

DEPARTMENT OF NATIONAL DEFENCE

CANADA

OPERATIONAL RESEARCH AND ANALYSIS ESTABLISHMENT

(14) ORAE [redacted] M103

(9) [illegible]

(6) # OPERATIONAL RESEARCH:
FLEXIBLE RESPONSE TO THE NEEDS OF
CANADIAN DEFENCE THROUGH THE POSTWAR YEARS.

A Paper For Presentation At The
Defence Science Symposium
Ottawa, Ontario, 19 November 1980

by

(10) G.R. Lindsey
Chief
Operational Research and
Analysis Establishment

OTTAWA, CANADA

(11) NOV[redacted]80

ABSTRACT

Operational research and systems analysis have developed to meet the changing needs of DND through the postwar years. Up to about 1965 the emphasis was on classical O.R. in field commands, studying operations and tactics, and systems analysis in the HQ in support of plans to procure new weapons systems. Since then there has been an increasing demand for analysis of logistics and manpower, and for research into strategic and economic problems. Recently, the large capital acquisition programs have re-established the need for systems analysis. The wide variety of topics studied in ORAE underlines the need for defence scientists with broad experience rather than specialists.

SOMMAIRE

Après la Seconde Guerre mondiale, la recherche opérationnelle et l'analyse des systèmes ont été orientés pour répondre aux besoins changeants du MDN. Jusqu'aux environs de 1965, on faisait surtout de la recherche opérationnelle traditionnelle à l'échelon des commandements en campagne, pour étudier leurs opérations et leurs tactiques, et analyser les systèmes établis aux QG, en vue d'appuyer les plans d'acquisition de nouveaux systèmes d'armes. Depuis lors cependant, il y a une demande de plus en plus forte pour l'analyse de logistique et de main-d'oeuvre et la recherche sur les problèmes économiques et stratégiques. Récemment, l'analyse des systèmes a de nouveau été rendue nécessaire à cause des grands programmes d'achat d'équipement. La grande variété de sujets étudiés au Centre d'analyse et de recherche opérationnelle souligne la nécessité d'engager des hommes de science possédant une vaste expérience plutôt que des spécialistes.

OPERATIONAL RESEARCH:
FLEXIBLE RESPONSE TO THE NEEDS OF CANADIAN DEFENCE
THROUGH THE POSTWAR YEARS

Contents

OPERATIONAL RESEARCH:
FLEXIBLE RESPONSE TO THE NEEDS OF CANADIAN DEFENCE THROUGH THE POSTWAR YEARS

I. DEFENCE RESEARCH 1939-1965

1. During World War II, the Cold War, and into the 1960's, it was not necessary to ask what Defence Research was, or to engage in introspection about its objectives. We all knew that defence was concerned with the deterrence or defeat of a foreign enemy, who would use military force if it suited his purposes. Our defence research concerned itself with the invention, development, and design of the weapons needed by our armed forces, together with other equipment needed to support the forces. Operational research, in particular, was concerned with the selection of weapons and with improvement of procedures and tactics for the employment of the weapons.

2. The sciences needed for defence research were mostly of the laboratory and equipment type, perhaps fairly characterized as "physical sciences". Typical defence science symposia in the 1950's or 60's had sessions on explosives and armament, military medicine, military electronics, and sonar. The main concerns of the senior officers in our defence departments included similar subjects. They wanted better explosives and armaments, better military electronics, and better sonar. When the scientists made these things possible, they were developed, manufactured, and issued to the armed forces. No doubt there were problems of budgetting, finance, selection, and procurement, but these seemed to be solved without much publicity or concern. The objectives in most of the planners' minds, and, apparently, of the government's too, were to get the best possible equipment into service as soon as possible.

3. That was what defence research was all about. To carry it out we needed engineers, physicists, chemists, mathematicians, and doctors. Similarly the operational research on weapons and tactics called predominantly for analysts with backgrounds in the "physical sciences", including mathematics and statistics.

4. Important applications of economic and psychological warfare had been made between 1939 and 1945, and research on selection and utilization of manpower and on training methods continued in the aftermath. Most of the researchers in these areas, and some in operational research, had professional backgrounds in economics, psychology, biology, or sociology. However, this type of defence research received low priority in the 1950's and 60's while the application of physical sciences to weapons systems and their employment increased.

II. EXTENSIONS TO THE SCOPE OF DEFENCE AND OF RESEARCH FOR DEFENCE

5. By the advent of the 1970's it had become much less clear just what the main concerns of a defence department in a country such as Canada should be. More attention was being paid to such things as multi-tasking formula financing, program planning budgetting, management by objectives, evaluation, accountability, performance measurement, and bilingualism. The acquisition of lethal hardware, although not forgotten entirely, had lost its former eminence.

6. Defence had changed. Evidently, the research appropriate for the solution of its problems needed to change too. The meaning of the words "defence" and also "strategy" began to be broadened far beyond the tactics and equipment of active combat between highly-organized armies on a well-defined battlefield. It began to cover international peace restoration and peacekeeping, preservation of national sovereignty, contributions of the defence establishment to national development, and consideration of the role and place of the soldier in society.

7. From the mid-sixties through the mid-seventies, as the real purchasing power of the fixed defence budget shrank, as the amount of new military equipment produced in Canada or even imported from abroad was reduced, and as the former emphasis on military contribution to NATO shifted towards support of Canadian national aims, the most serious decisions facing defence officials and their political superiors in our country had an increasing content of strategic policy and of finance, and less of the selection of the products of the latest engineering technology. Questions of manpower and logistics assumed greater importance, those of new equipment and tactics were less and less prominent. The number of personnel in uniform shrank from 125,000 to 78,000. The inflating costs of personnel, operations, and maintenance were consuming nearly 90% of the budget, leaving very little for capital acquisition. The importance of such concerns as mobilization, war resources, reinforcement and resupply, and operational readiness, which had assumed priority in the earlier years, faded into the background.

8. During the 1970's there have been searchings into the problems of international stability, and into the rationale for Canadian defence forces. These produced a need for a new type of defence research, involving strategic and social studies, many of which have been undertaken by DND's Operational Research and Analysis Establishment. It is questionable whether they should be described as Operational Research, but we consider them to be defence analysis.

9. Then, late in the 1970's the cumulative effect of equipment approaching obsolescence without replacement by modern systems put the armaments of the Canadian Armed Forces into a posture that could be neglected no longer. It was decided that substantial sums of new money would be made available for badly needed capital equipment, and that this would be selected and acquired through a carefully controlled and highly systematic planning process, including indexing for inflation. In support

of these programs, ORAE found itself engaged in research better described as systems analysis than as operational research.

III. ORGANIZATION PRIOR TO 1968

10. Until the mid-1960's, O.R. teams worked as a part of the headquarters staffs of the Army, Navy, Air Force, the Defence Research Board and with many of the military commands. The largest team formed was the Canadian Army Operational Research Establishment. The Army preferred to concentrate its operational research in the national headquarters, while the Navy and Air Force chose to place O.R. sections with their major commands as well as in the headquarters.

11. Task setting and daily direction were decentralized. The O.R. groups working with the military reported to specified senior staff officers. The provision of civilian scientists, however, was the responsibility of the Defence Research Board, as was their personnel administration and career management. Small numbers of scientists were also posted to international military organizations and research centres, or exchanged with allied establishments. In this way the scientists could be offered a varied career with opportunities for change and advancement; in fact most of them had worked with the staffs of two or even three services by the time unification of the armed services became a reality in 1968.

IV. ORGANIZATION SINCE 1968

12. Integration of the National Defence Headquarters, followed by unification of the three services, produced a far greater organizational upheaval in the Canadian Armed Forces than it did in the operational research community which served them. Integration of the HQ passed through a bewildering series of reorganizations between 1964 and 1968, by which time it became possible to structure the operational research community into a

form able to work within the new integrated national HQ, and also to continue to provide personnel for the military commands.

13. The objective of the new organization was to be able to provide a central service to any part of the national HQ needing operational research or systems analysis, as well as to supply suitable scientific personnel to man O.R. sections with the operational commands. But instead of simply supplying groups to work under the decentralized direction of those offices in HQ to which they reported, the scientists were held on the strength of a central Defence Research Analysis Establishment. They were organized into directorates for internal control, but tasks accepted by the establishment could be parcelled out to teams drawn from more than one of our directorates as well as from other sources, when this was appropriate. Some directorates did most of their work for one sponsor, others had programs responding to the requests of several.

14. A common factor in many of the important advances in scientific research in the last two decades has been the combination of two or more disciplines, formerly considered to be self-contained and, if you like the word, "pure". In many instances, the hitherto unexplored no-man's land between the specialties has turned out to be extremely productive. Thus, in the physical science, we are now used to biochemistry and biophysics, and can even tell the differences between geophysics and physical geography.

15. To a certain extent, a cycle which began with the pioneers of "natural philosophy" in the eighteenth and nineteenth centuries has gone full circle. Natural scientists then became specialists, and scholarship divided into distinctly separate channels. But some of these channels are coming together again in the second half of the twentieth century, even in university departments usually considered to be the last bastions of purity and specialization.

16. This combination of backgrounds and disciplines has been a natural feature of both operational research and systems analysis, throughout their short histories. Some of the character of operational research was determined by the fact that the wartime O.R. groups were recruited mainly after the mobilization of most of the available chemists, physicists, engineers, and mathematicians for work on projects such as explosives, radar, sonar, weapons, and vehicles. Fortunately, the experience of scientists from fields such as biology or astronomy prepared them for many of the constraints of wartime operational research, including limitations to opportunities to design controlled experiments, to make observations, non-reproducibility of results, and obligation to infer conclusions from small quantities of inadequately controlled data.

17. I would like to make it clear that "systems analysis" as defined by our organization is a much broader, more challenging, and more interesting activity than that carried out by the computer programmers or automaters of accounting systems who advertise for "systems analysts", with salaries greater than we can pay. It does involve computers, where applicable, but only as a tool. It is associated with the planning, simulation, and comparison of future systems, whereas operational research is more concerned with existing systems whose operations can be studied in actual practice. If systems-in-being are studied by simulation, the process is usually much simpler than it is for hypothetical systems of the future, since the former are constrained by the known capabilities of existing hardware.

18. It is not helpful to try to draw a finer line of demarcation between operational research and systems analysis; laws of behaviour need to be deduced from existing systems and, suitably modified, applied to the design and analysis of future systems. Neither is it my purpose today to extoll the fruitful combination of the two disciplines of operational research and of systems analysis, but, rather, to describe the opportunity offered by

both, in the sphere of defence research, to use the talents of a variety of the more basic academic disciplines. And, whereas in the 1940's and 1950's these featured mathematics, engineering, and physics, with an acceptance of other semi-quantitative disciplines such as chemistry or biology, now in the 1980's there are opportunities for economists, historians, political scientists, and sociologists. We have managed to preserve the category of "Defence Scientist" in the Public Service occupational groupings, which is highly desirable for our laboratories, and even more vital for the Operational Research and Analysis Establishment.

19. Together with the laboratories and staff of CRAD, we have demonstrated that research positions can be filled with greater continuity, and with a consistently better quality of scientist, when the scientist belongs to a group which provides standards of quality, and a loose centralized organization that can match the individual to the task, and can give a reasonable assurance of a varied and progressing career that may be highly specialized or very general, depending on the needs of defence and the preferences of the scientist.

V. ACTIVITIES INSTITUTED IN RECENT YEARS

20. Unification of the CAF offered opportunities to rationalize the supply system, formerly acquiring and feeding three sets of materiel through three separate networks of depots. Quite apart from unification, logistics offers many problems very suitable for analysis, including policies for maintenance, repair and replacement, for inventory stocks, for handling of lifed items, and for the provisioning of an initial set of spare parts for a newly-acquired ship, aircraft, tank, or other major system with a long expected life.

21. This type of logistical analysis has many parallels in industry, but important differences are present too. While

cost is a major consideration for DND, there is no profit to be made, and it is difficult to impute a realistic cost to a stockout or failure. The variety of items in the military supply system is simply enormous, and the rates of turnover cover a very wide range. There is a role for marginal analysis, so that the investment in spare parts is wisely distributed with regard to risks and costs. This poses a special problem in the initial acquisition of spares for a large new system, when insufficient stocks may result in very large expenditures for reordering at a later date.

22. Rationalization of the supply system had a counterpart in manpower when the CAF were unified. Many specialized trades could be merged among land, sea, and air, although this posed certain problems in training, rank structure, and pay grading. The number of personnel involved, the large number of highly standardized categories, and the importance of planning careers over a period of many years, all pointed to analysis by mathematical models, although the use of computers to deal with personnel problems is, or at least was until quite recently, anathema in some quarters. One significant advantage of a good model is to indicate the long-term consequences of an immediate change in policy, and an area where the system cannot await or tolerate the method of trial and error. Development of the theory of goal programming has been followed by very useful practical results in our analysis of manpower problems in the CAF.

23. Another application of analytic methodology to a practical problem in personnel administration has been made to the transfer of servicemen between posts in a particular trade group. Many factors need to be taken into account, with a certain limited degree of flexibility acceptable in most of them. For example, a radar crew established at a strength of eight could probably survive for a limited period with only six, but could usefully

employ ten. A posting usually set for three years could be reduced to two or extended to four. Constraints may need to be applied to particular posts or particular individuals, perhaps on grounds of language or medical requirements, whether of the serviceman or his dependents. In general, the requirements of the organization can be put into the computer program, and its solution, perhaps specified to minimize moving costs, is then presented and subjected to human veto, on grounds of the requirements or particular circumstances of the individual. When a new constraint is added, the computer presents a new solution to be accepted or modifed by the career manager. For example, the computer may be constrained not to post Corporal Cluseau to the same station as any of his previous Commanding Officers.

24. An area of increasing interest is that of arms control. In principle, a country or an alliance could obtain security by either of two methods: it could unilaterally design and build military forces sufficient to offset those of its principal adversaries, or it could attempt to negotiate with the adversaries a level of forces on both sides that would leave each in a relative position sufficiently strong to provide a tolerable degree of security. The second approach requires cooperation, provisions for verification, and a certain common appreciation of many factors. A prerequisite is a comprehensive analysis of the situation at present, and of what could develop in the future. NATO does undertake such analyses, depending on its member countries for the studies, discussion, and criticism.

25. Since Canada has decided to entrust its security to a policy of collective defence, with the USA in North America and with the countries of the North Atlantic Alliance in the Western World, it is obliged to arrive at its policies for both armament and disarmament against the background of the NATO/ Warsaw Pact balance and against developments tending to strengthen or weaken the stability of deterrence. Many of the analyses of

these problems are carried out collectively by groups in the NATO capitals. As in the other capitals, the Canadian analyses involve defence scientists as well as military, diplomatic, and other personnel, including scientists from other government departments. Over the years, Canada has made considerable contributions to the study of the verification of arms control agreements, starting with extensive air sampling for above-ground nuclear testing and seismic monitoring for underground nuclear testing. Present activity includes analysis of past and present procedures for verification of agreements on numerical and geographical deployment of weapons and forces.

26. It has seemed to some of us that economists have neglected defence as a field for their research. Incredible efforts are expended by government analysts on the economic aspects of development, aid, welfare, fiscal policy, and inflation. Many of us are waiting hopefully, if increasingly impatiently, for the solutions to emerge. But defence is a large enough activity to weigh in the national economy, even in Canada, and to pose its own internal problems. I am not speaking here of programming and budgetting, but of questions such as the difference between the bills paid by DND and the real net cost to the country, when allowance is made for taxes, employment, and spinoffs; or the true marginal cost or saving if one ship, aircraft, or other basic unit is added or deleted, while the basic overhead remains in place. We have made studies of the economic contribution of a Canadian Forces Base to the surrounding community, a subject often raised when consideration is being given to base closures. At the moment we are involved in a complex study of the relationship between expenditure on capital equipment and on operations and maintenance.

27. There are practical problems facing the armed forces that involve applied sociology. Some of the changes that are occurring, such as marriages at a younger age, increased presence of women and of married couples in the forces, and growing

reluctance to subordinate the preferences of the family to the requirements of the service, are having significant effects on service life and on patterns of retention. There is a large ongoing study of the characteristics and problems of military families - that is, families in which the husband, the wife, or both are in the Canadian Forces. Studies have been made of the social effects of C.F. bases on the surrounding communities. Another study has investigated the significance of a variety of factors on morale in combat. And, outside of the armed forces, we have attempted to identify various indicators that could be used to give warning of internal disorder and unrest.

VI. CONTINUATION OF CLASSICAL O.R. AND S.A.

28. Finally, having traced the new developments through logistics, manpower, strategy, economics and sociology, let me return to the original areas in which operational research began. We still devote a large proportion of our effort to the analysis of weapon systems, tactics, and operations, and much of this is done by small O.R. sections resident with the field commands. Systems analysis has been considerably expanded to support the major programs of capital acquisition. In all recent major cases, the total amount of money available for acquisition has been specified in advance of the decision, so that the problems are those of optimizing the return from a known investment. However they are by no means simple, since several military roles are always involved and it is necessary to take account of many economic aspects of the programs such as industrial benefits.

29. For a number of years one of the main activities in support of the land forces has been the research war game. At the level of brigade or battalion combat, there is too much fine detail to permit practical computer simulation. So we operate a game which models terrain, intervisibility, mobility, weapon performance, and a host of other factors and presents many decisions for human judgement. A great deal of research

goes into the rules and probability tables used in the game. It has several variants, the most common being situations faced by 4 CMBG or the CAST Combat Group opposing a Soviet armoured assault in Germany or Norway. Either present or future equipment can be assessed. The game can be, and frequently is, used for training instead of research in which case it proceeds at a faster pace and without the need to keep detailed records.

30. But war gaming is not our only activity in support of land forces. We are very much concerned with analysis of many problems concerning land force systems, such as: assessment of possible new tactics for armed helicopters in support of the land battle; development of simulation techniques to study the effectiveness of various ground based air defence systems to protect both our airfields and land forces; studies of the best way to use our tactical aircraft - recce, close support, interdiction; determination of appropriate roles for infantry in future armoured warfare. These are some examples of problems that have to be resolved by studies or analyses other than war gaming, so that the resources involved can be properly used in the game.

31. The two largest foci of maritime O.R. and S.A. have been devoted to support of the LRPA acquisition, culminating in the procurement of the Aurora, and of the Canadian Patrol Frigate, still under study. Planning for the Aurora LRPA began about fifteen years before initial delivery, and O.R. studies had a large part to play in refining the requirements and making the selection, especially as regards the type of avionic equipment to be acquired.

32. Planning for the CPF began about ten years ago when it was recognized that all the destroyer-type ships, except the four DDH 280 class, would reach retirement age within a span of about ten years. This seemed like an excellent opportunity to take an

analytical look at the entire Canadian Navy, to determine what kind of fighting ships it should comprise by the turn of the century, and if there was a logical and practical way of implementing such a fleet within a set of projected constraints such as money, manpower, technology. The outcome of these early studies suggested that the time for the first class of ships to be replaced, the St Laurents, was so close at hand that there would be insufficient time available to consider anything other than a conventional hull-type ship as the replacement. Thus, the basic characteristics of the current CPF were determined. Present studies associated with the CPF Program are concerned with the types of equipment or systems that should be fitted to give the ship the best fighting capability possible for the money available. Analyses are also concerned with striking an appropriate balance between self defence systems and attack systems. Looking ahead to the not too distant future ship replacement programs, the cramping constraint of time becomes less significant, so that we need not restrict ourselves to considering only conventional type hulls. The characteristics of the follow-on batches of ships are under investigation now in what we call the Future Ship Study, which is being conducted along the lines of a Long Term Scientific Study, and involves military (both technical and operational staff) and defence scientists (both laboratory scientists from DREA and operational research scientists from ORAE).

33. The two main recent activities in O.R. and S.A. applied to the Air environment have been support of the acquisition program for the new fighter aircraft and analysis of search and rescue operations. The former has now been completed with the decision to purchase the CF-18A. In this area, attention is now concentrated on the selection of the weapons that the CF-18A should carry. Later on today, Dr. Brereton will be speaking to us about "Simulation and Assessment in Air Defence".

34. Air search for downed aircraft or ships in distress is

a classic problem for operational research, but now needs to be modified to take advantage of new devices such as The Emergency Location Transmitter and the Search and Rescue Satellite.

35. The activities that I have just discussed in support of land, maritime, and air operations represent some examples of the type of work done by ORAE staff in Ottawa - work done in support of the DCDS Group which is concerned with the next generation of systems to be acquired for the Canadian Forces. To a large extent, the analysis done in this area of endeavour is what we call systems analysis. It results in the production of information concerning future systems to enable the senior military decision makers to make enlightened decisions about future acquisitions.

36. The work done by ORAE staff at the Command level is traditional or classical operational research, since it is concerned with the analysis of forces in being, to try to get the best out of what we now own and operate. Most, by far, of the O.R. done at Command level is in the area of maritime and air operations. In maritime operations, O.R. techniques are used to assess current operations and provide intelligence information; they are used to evaluate current weapon systems such as the Mark 46 torpedo now in service; they are used to schedule and control conversion training for the introduction of new systems such as the AURORA aircraft; they are used in the analysis and assessment of ASW exercises. In air operations, some of the problems which have arisen concern the analysis of aircraft attrition statistics; studies of maintenance operations at interceptor bases; development of requirements for an Air Operational Information System; and planning and scheduling airlift for operations and exercises. The small O.R. team co-located with CFE Headquarters has recently been involved in an interesting analytical study to determine the firing doctrine that could produce the highest possible score in the Army Trophy

Competition. This O.R. team has also been concerned with assessing damage to airfields that could be sustained in an air raid; with the analysis of personnel data to assist in planning of housing and other services; with a reassessment of the Mayflower plan for evacuation of dependents from Lahr to Canada, the reassessment being required in the light of facilities needed to accommodate wide-body jet aircraft. All of the Command O.R. sections have been tasked with developing methodology to handle Performance Measurement for the respective Command operations.

37. As well as the research in these comparatively well-defined areas, there is a continuing series of trials and tests conducted by the Canadian Forces. These extend from comparison of the types of dental treatment to the selection of small arms for NATO. ORAE provides assistance for the design and analysis of some of these trials.

VII. CONCLUDING REMARKS

38. The postwar history of O.R. and S.A. in DND has mirrored the experience of the armed forces in many ways. A buildup of well-equipped forces in the fifties offered great scope for the classical type of analysis. The sixties saw the end of expansion and a growing concern for economy, the seventies brought reduction, retrenchment, and a questioning of roles, strategy, and even raison d'être. Questions of logistics and manpower came to the fore, followed by analysis of international commitments, defence priorities, arms control, economics, and social concerns. Now in the eighties there is some sign of a return, part way at least, to re-equipment and training for modern combat.

39. There is an ever increasing demand of ORAE's services - the requirement for classical operational research never markedly

diminished even during the period in which few weapons were being acquired. At the same time the growing need to economize on the support of the forces, and the growing potential of computer modelling methods to allow economies to be effected, have increased the number of areas in which analysis can be done, and in fact must be done, if the new tools are going to be exploited. During the same period the demand for strategic, social and economic analysis has steadily increased. There has been a change in the type of demand as well as an increase in number. Increasingly problems are arising that require large investments of manpower to effect solutions. It is still possible to solve some of the problems by the classic "back of the envelope" approach - but these are becoming fewer and fewer, - perhaps because most of the simpler problems have already been solved. More typically now a group of two to four analysts may have to spend a total of one to four man-years on a problem, a significant percentage of which is invested in understanding the problems in detail, and the complex methodologies likely to be needed for their solution.

40. Defence science has a contribution to make to all of these matters. Some are primarily technical, but most require knowledge and understanding far beyond the boundaries of the laboratory or the textbook. As is the case in the defence laboratories, ORAE tries to develop not mathematicians, physicists, historians, or sociologists, but defence scientists with a broad experience in the scientific problems of defence and the flexibility to respond to them whether they are brand new or recognizable as a return of one we have seen before.

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall document is classified)

1 ORIGINATING ACTIVITY
Department of National Defence
Operational Research and Analysis
Establishment

2a. DOCUMENT SECURITY CLASSIFICATION
UNCLASSIFIED
2b GROUP

3 DOCUMENT TITLE
Operational Research: Flexible Response to the Needs of Canadian Defence Through the Postwar Years.

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)

5 AUTHOR(S) (Last name, first name, middle initial)

Lindsey, G.R.

6 DOCUMENT DATE
November 1980

7a. TOTAL NO. OF PAGES
20

7b NO. OF REFS

8a. PROJECT OR GRANT NO.

9a. ORIGINATOR'S DOCUMENT NUMBER(S)
ORAE Memorandum No. M103

8b. CONTRACT NO.

9b. OTHER DOCUMENT NO.(S) (Any other numbers that may be assigned this document)

10 DISTRIBUTION STATEMENT
Qualified requesters may obtain copies of this document from their defence documentation center.

11 SUPPLEMENTARY NOTES

12. SPONSORING ACTIVITY
ORAE

13 ABSTRACT Operational research and systems analysis have developed to meet the changing needs of DND through the postwar years. Up to about 1965 the emphasis was on classical O.R. in field commands, studying operations and tactics, and systems analysis in the HQ in support of plans to procure new weapons systems. Since then there has been an increasing demand for analysis of logistics and manpower, and for research into strategic and economic problems. Recently, the large capital acquisition programs have re-established the need for systems analysis. The wide variety of topics studied in ORAE underlines the need for defence scientists with broad experience rather than specialists.

KEY WORDS

Operational research
Systems analysis
Logistics
Manpower
Economic problems
Strategy

DSIS
78-841

KEY WORDS

INSTRUCTIONS

1. ORIGINATING ACTIVITY. Enter the name and address of the organization issuing the document.

2a. DOCUMENT SECURITY CLASSIFICATION: Enter the overall security classification of the document including special warning terms whenever applicable.

2b. GROUP: Enter security reclassification group number. The three groups are defined in Appendix 'M' of the DRB Security Regulations.

3. DOCUMENT TITLE: Enter the complete document title in all capital letters. Titles in all cases should be unclassified. If a sufficiently descriptive title cannot be selected without classification, show title classification with the usual one-capital-letter abbreviation in parentheses immediately following the title.

4. DESCRIPTIVE NOTES: Enter the category of document, e.g. technical report, technical note or technical letter. If appropriate, enter the type of document, e.g. interim, progress, summary, annual or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the document. Enter last name, first name, middle initial. If military, show rank. The name of the principal author is an absolute minimum requirement.

6. DOCUMENT DATE: Enter the date (month, year) of Establishment approval for publication of the document.

7a. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7b. NUMBER OF REFERENCES: Enter the total number of references cited in the document.

8a. PROJECT OR GRANT NUMBER: If appropriate, enter the applicable research and development project or grant number under which the document was written.

8b. CONTRACT NUMBER: If appropriate, enter the applicable number under which the document was written.

9a. ORIGINATOR'S DOCUMENT NUMBER(S): Enter the official document number by which the document will be identified and controlled by the originating activity. This number must be unique to this document.

9b. OTHER DOCUMENT NUMBER(S): If the document has been assigned any other document numbers (either by the originator or by the sponsor), also enter this number(s).

10. DISTRIBUTION STATEMENT: Enter any limitations on further dissemination of the document, other than those imposed by security classification, using standard statements such as:

(1) "Qualified requesters may obtain copies of this document from their defence documentation center."

(2) "Announcement and dissemination of this document is not authorized without prior approval from originating activity."

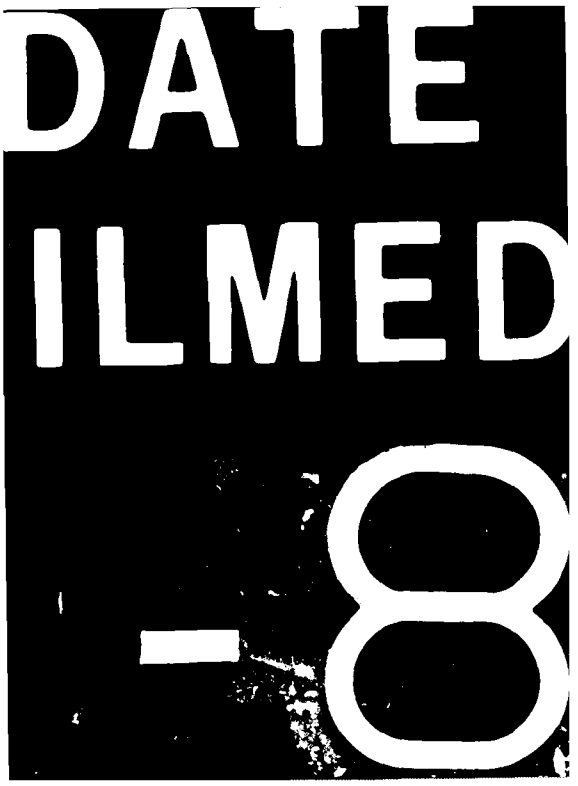
11. SUPPLEMENTARY NOTES: Use for additional explanatory notes.

12. SPONSORING ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring the research and development. Include address.

13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document, even though it may also appear elsewhere in the body of the document itself. It is highly desirable that the abstract of classified documents be unclassified. Each paragraph of the abstract shall end with an indication of the security classification of the information in the paragraph (unless the document itself is unclassified) represented as (TS), (S), (C), (R), or (U).

The length of the abstract should be limited to 20 single-spaced standard typewritten lines, 7½ inches long.

14. KEY WORDS: Key words are technically meaningful terms or short phrases that characterize a document and could be helpful in cataloging the document. Key words should be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context.


DATE
ILMED
-8